REMARKS

Applicants thank the Examiner for the very thorough consideration given the present application. Claims 1 and 4-8 are currently pending in this application. No new matter has been added by way of the present amendment. For instance, the amendment to claim 1 is supported by the attached partial English translation of the standard configuration specification of Surfscan 6220, which specifically discloses that the minimum wafer diameter measurable by this device is 2 inches. New claim 8 is supported by previously presented claim 1. Accordingly, no new matter has been added.

In view of the amendments and remarks herein, Applicants respectfully request that the Examiner withdraw all outstanding rejections and allow the currently pending claims.

Substance of Interview

Applicants thank the Examiner for the time, helpfulness and courtesies extended to Applicants' representatives during the Interviews of February 19 and February 24, 2010. The assistance of the Examiner in advancing prosecution of the present application is greatly appreciated. In compliance with M.P.E.P. § 713.04, Applicants submit the following remarks.

The Interview Summary form issued on March 3, 2010 summarizes the discussions at the Interviews. The outstanding rejection of the claims was discussed. Applicants reaffirmed their previous position that the prior art of record fails to teach or suggest every aspect of the present invention. Various ways of addressing the prior art rejection were discussed, including possible claim amendments.

Issues under 35 U.S.C. 103(a)

Claims 1 and 4-7 stand rejected under 35 U.S.C. 103(a) as being obvious over Nakamura (U.S. 5,434,100) (hereinafter "**Nakamura**") in view of "Mirror Polishing of InP..." (hereinafter "**Morisawa**") and Westhoff (U.S. 2004/0214407) (hereinafter "**Westhoff**"). Applicants respectfully traverse.

The Examiner notes initially that the present claims define the substrate in terms of how the same reacts to characterizing incident radiation (see page 2 of Office Action). The Examiner further notes that Applicants' reply of 9/21/09 confirms Examiner's previous interpretation that haze is not a direct physical characteristic of a surface of a material, but is rather "a result of a combination of direct characteristics of the material surface," and further "additionally depends on the extraneous characteristics of the wavelength and angle of observation of the scattered reflection" (see pages 2-3 of Office Action).

The Examiner additionally notes that "[a]t best...the specification of this application describes measuring haze using 488 nm, but is silent on the angle of measurement. And only claims 1, 4, and 5 recite the haze of the InP substrate being measured at 488 nms" (see page 4 of Office Action).

Based on the Examiner's interpretation of the claim language, the Examiner concludes that "obtaining an epitaxial InP substrate having a haze of not more than 1 ppm, as recited in claims 1 and 7...would have been obvious" (see page 4 of Office Action). Specifically, the Examiner notes that Nakamura discloses an InP substrate having an off-angle direction of 0.05-0.1 degrees from the <100> direction, having a density of dislocation of less than 100 at such off-angles. The Examiner relies on several assumptions with regard to the number of dislocations

in the substrate of Nakamura, and the probability of dislocations being present therein, and concludes that "[t]he Nakamura disclosed substrate therefore would be free of dislocation caused haze because its surface would have 4443 no dislocation 15X15 micron squared regions for every single 15X15 microns squared region having a single dislocation. And at least over these 4443 no dislocations...regions, the haze due to dislocation would be zero" (see Office Action, pages 4-5).

The Examiner acknowledges that the issue remains as to whether haze due to surface roughness would exist in the mirror finished surface of the InP substrate of Nakamura, and relies on Morisawa, asserting that this reference teaches haze-free InP substrates subjected to mirror polishing (see page 5 of Office Action).

Applicants respectfully submit that the Examiner has failed to establish a *prima facie* case of obviousness. To establish a *prima facie* case of obviousness, the Examiner must make the factual determinations set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966). "[T]he examiner bears the initial burden, on review of the prior art or on any other ground, of presenting a *prima facie* case of unpatentability." *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992). A patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. *KSR Int'l Co. v Teleflex Inc.*, 82 USPQ 2d 1385 (U.S. 2007). There must be a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does. *Id.* The Supreme Court of the United States has recently held that the "teaching, suggestion, motivation test" is a valid test for obviousness, albeit one which cannot be too rigidly applied. *Id.* "[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements;

instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *Id.* (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)).

(A) The present invention

Applicants respectfully submit that none of the references cited by the Examiner teaches or suggest an InP substrate as claimed, wherein every portion of an effectively used area measured by Surfscan 6220 exhibits a haze of not more than 1 ppm, the InP substrate having a size of at least two inches, and wherein the InP substrate comprises an off-angle with respect to a plane direction of 0.05° to 0.10°. The references are also being improperly combined.

Moreover, Applicants note that, contrary to the Examiner's assertion, haze is affected by many factors, such as defects in the crystal, surface roughness, thickness of an oxidized film generated naturally on the wafer surface and residual contaminants on the wafer surface. Multiple factors must be controlled in order to control the factors that affect haze.

(1) Factors which affect the haze

Factors which affect the haze within a certain area include not only the defects caused in the crystal and/or surface roughness, but also many others. The interaction of these multiple factors results in changes in haze values. For instance, some factors which influence haze include (a) and (b).

(a) Oxidized film generated naturally on the wafer surface

An oxidized film is inevitably generated, regardless of the kind of wafer used. The haze value increases drastically when the film is partially thickened. Accordingly, it is important to

keep the oxidized film sufficiently thin and even, and to do so in a stable manner. In order to accomplish this, many other factors must be controlled.

First, immediately after the final mirror polishing has been performed, the polishing agent should be quickly removed from the wafer surface (e.g., millisecond time scale), so as to prevent an unnecessary reaction between the polishing agent and the wafer surface. Next, in the final washing processing after the final mirror polishing, generation of the thick oxidized film should be prevented. Finally, the completed wafer should be stored in an environment which is safe from oxidation (such as in an atmosphere of contamination-free nitrogen, inactive gas, etc.), and temperature variations must be avoided (because dew condensation can also cause haze increase), so as to maintain an appropriate storage environment until its usage.

(b) Residual contaminated substances on the wafer surface (both organic and inorganic)

First, an organic solvent and alcoholic components included in the agent, used in the final washing processing after the mirror polishing, should not be left on the wafer surface. This is because these residues will form a film on the wafer having a thickness at a molecular level, which will remain on the wafer surface even after the wafer is dried. Next, abrasive grains which are used in the polishing processing should be washed off so as not to be left on the wafer surface. Finally, various cleaning solutions used in the final washing processing, impurities dissolved in the etching solution, contaminated substances floating in the solutions without being dissolved therein, the particles thereof, etc., should be removed as thoroughly as possible.

Clearly, haze is affected by a very complex combination of factors other than the crystal

defects and surface roughness.

(2) Haze Area

Applicants respectfully note that the present claims require that every portion of an effectively used area of a wafer measured by Surfscan 6220 exhibits a haze of not more than 1 ppm.

An InP wafer is a plate-shaped substrate having a diameter of 50.8 mm (2 inches) or more. As such, the claimed haze value indicates the value for the entire effectively used area on that wafer surface. In the present invention, the haze is measured by the Surfscan 6220 manufactured by KLA-Tencor corporation. As shown by the attached document, the minimum wafer diameter measurable by this device is 50.8 mm (2 inches) (see page 3 of the enclosed standard configuration specification of Surfscan 6220, and partial English translation thereof). As such, the claimed haze is measured for an area of at least 50.8 mm (2 inches).

(B) The Cited References

(1) Nakamura

Nakamura discloses a technique of adjusting the off-angle of a wafer in a predetermined range in order to reduce tear-droplike hillock defects and wrinkled defects at the time of epitaxial growth. However, Nakamura does not teach or suggest the claimed haze for a wafer having the size and the shape as in the present invention, or for the epitaxially grown surface on the wafer.

But besides such a deficient disclosure, Applicants note that teardrop-like hillock defects and wrinkled defects of Nakamura are completely different from haze. Moreover, although the

laser light of Nakamura may indirectly result in some haze reduction, this does not necessarily mean that the haze value measured by a Surfscan 6220 in Nakamura would always be not more than 1 ppm, as presently claimed.

As discussed above, the claimed haze value cannot be obtained unless multiple factors in sophisticated techniques of mirror polishing, final washing, and drying processing are all at once satisfied to, for example, prevent the generation of a thick oxidized film on the surface of the wafer, etc.

Not only is Nakamura silent with regard to the above mentioned processes, but this reference does not even mention haze values or how to control them. Therefore, the skilled artisan would not have been able to arrive at an InP wafer with a haze value of not more than 1 ppm based on the teachings of Nakamura. Further, Nakamura is not properly combined with the cited secondary references.

(2) Morisawa

Morisawa discloses measuring the surface roughness of a wafer by a surface roughness measuring equipment using a sensing pin, called "Tarystep", and an atomic force microscope (AFM) called "NanoScope-II". Morisawa further discloses evaluating the wafers and identifying them as "no scratch free" and "haze free", after analyzing a chart diagram and three-dimensional distribution diagram of the measured roughness.

Applicants note that this document discloses measuring and analyzing the roughness of the finished wafer surface as a result of "mirror polishing processing" in a narrow sense, which cannot at all be discussed in the same context as the haze measurement evaluation in the whole

surface of the wafer using a laser light source such as Surfscan 6220 (as presently claimed). For instance, in the measurement method disclosed in Morisawa, the evaluation cannot be performed for haze which is caused by factors other than the surface roughness.

Moreover, influences on the haze value obtained by using the laser light source, caused by unevenness and waveform difference of the surface roughness cannot be evaluated, thus resulting in less accurate results (as compared to the present invention).

Applicants further note that a haze value can be large when measured by a laser light source even on a smooth surface with hardly any surface roughness, due to the thick oxidized films or organic contamination generated on the wafer surface. As previously discussed, the present invention defines haze as "a value calculated by dividing intensity of scattered light obtained when light is incident from a predetermined light source onto a surface of the substrate, by intensity of the incident light from the light source." As such, Applicants respectfully submit that haze values measured by other means are irrelevant.

Applicants further note that the Examiner has taken the position that haze also depends on extraneous characteristics of wavelength and angle of observation of the scattered reflection. Applicants respectfully disagree. In Surfscan 6220, the laser light source and the detector (PMT) are disposed in a layout as shown in FIG. 1 of the present application. The laser light irradiates light vertically toward the wafer surface, and the laser light reflected by the wafer is to be scattered when haze exists. The detector is disposed in a position which is inclined by 60° with respect to the perpendicular line of the laser light, given the point where the laser light hits the wafer surface as the starting point. This position may also be described as a position which is inclined by 120° with respect to the wafer plane, given the point where the laser light hits the

wafer surface as the starting point. The arrangement of the above described layout is not something that one can adjust anytime, except for checking at maintenance whether it is not deviated, but is fixed as an inherent set value designed for the device.

(C) Westhoff

Westhoff discloses the use of SurfScan 6220 and further discloses that haze is a significant indicator of the surface evenness. However, this reference does not in any way teach any technical elements which may directly or indirectly suggest the present invention. Westhoff is not properly combined with Nakamura and Morisawa, and the rationale for such a combination is improper.

(C) Conclusion

Applicants respectfully submit that none of the cited references disclose or suggest the claimed combination of the haze and the off-angle of the substrate before epitaxial growth, and thus fail to render the present invention obvious. The references are also improperly combined as explained above.

In view of the above, reconsideration and withdrawal of this rejection are respectfully requested.

Miscellaneous - IDS

Applicants note that several references cited in an IDS of September 15, 2006 were crossed out by the Examiner. These references, however, should have been considered. The

following explanation is provided for the Examiner's convenience.

JP–2750331 corresponds to U.S. 5,434,100, which was considered by the Examiner and is of record in the present application. JP-3129112 corresponds to U.S. 5,647,917, also of record, and also considered by the Examiner. Thus, these two Japanese Publications should be considered and made of record.

Further, although JP 2001-189278 was incorrectly cited as JP 2001- 189276, the correct document was filed with the USPTO. The submission of JP-9-278582 and JP 2001-189278 was proper under U.S. patent rules (see MPEP 609.04(a)). Thus, the Examiner should have considered all of the cited references.

Applicants enclose herewith the references and IDS of September 15, 2006 for proper consideration.

Conclusion

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding rejections and objections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Office Action and, as such, the present application is in condition for allowance.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Vanessa Perez-Ramos, Reg. No.

61,158, at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.17; particularly, extension of time fees.

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Respectfully submitted,

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Enclosures: Partial English Translation of standard configuration specification of Surfscan 6220

References and IDS of September 15, 2006